Rotary MR Damper for Launch/Landing Load Isolation and Resistive Crew Exercise for Exploration Spaceflight Missions

Completed Technology Project (2013 - 2013)

Project Introduction

Develop a rotary MR (magneto rheologic) Damper to integrate into exploration spacecraft crew seats to be used as an exercise device and launch/landing load isolation system. Rotary motion of human joints (knees, elbows, ankles, hips) may be opposed by the resistive torque developed by the MR damper. Experience obtained from prior ICA funding where a linear MR damper device was developed pointed to minimizing complexity and the conception of this rotary MR damper. MR technology is well understood, has flown on the ISS and commonly found in automotive adaptive suspension systems. May be integrated into wheelchairs, beds, etc. to provide exercise to handicapped persons. A rotary, electrically-controlled damper has applications in any motion-control system that employs rotary motion in environments with vibration, shock or braking loads, such as conveyors, steering, brakes or clutches. A high resistive torque damper does not currently exist. This invention allows high resistance to be developed.

Resistive crew exercise equipment for Orion and other exploration spacecraft will be severely impacted by space constraints in both storage and use. Development of a compact, high variable torque rotary damper will facilitate the design of exercise equipment. Rotary motion is the most direct when applied to human joints, such as knees, elbows, hips and ankles. On a prior ICA funded project, linear magneto-rheologic dampers were used on an exercise device. Converting joint rotary motion into linear motion on the damper required additional mechanisms with weight penalties. Once this compact rotary MR damper is developed, it may be integrated with the Orion Crew Seat to be used as a resistive exercise device as well as a launch/landing load damper. This also allows the seat to have dual use as a seat for launch/landing and as an exercise device.

Anticipated Benefits

Used as a vibration isolation system for exercise devices used on the International Space Station.

Used as a resistive exercise device - either as an exoskeleton worn by crew members or mounted to a crew seat in the ISS or Orion

Used to isolate landing shock loads for crew seats in any crewed capsule.

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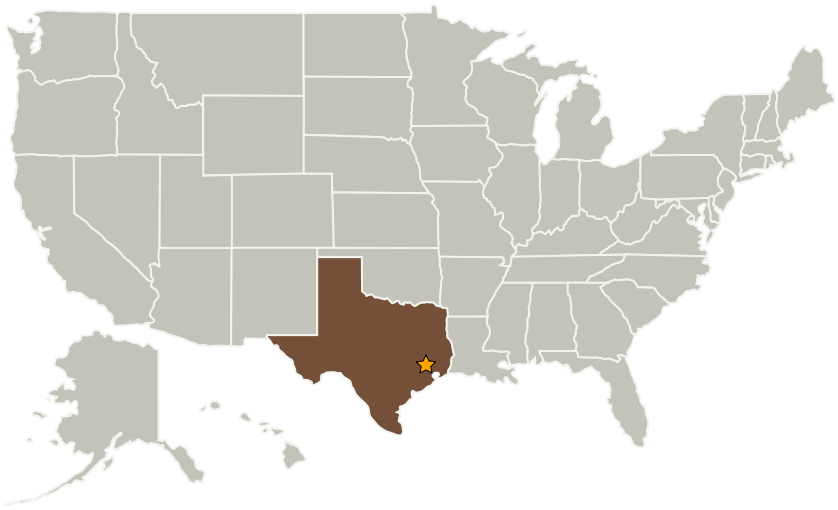
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Jacobs Engineering Group, Inc.	Supporting Organization	Industry	Dallas, Texas

Primary U.S. Work Locations
Texas

Links

NTR 1
(https://invention.nasa.gov/ntr/viewTech.html?fn=/data/other/review_bin/technology/inventors/47349bb3_6eda_2301_8541_7155ef1b19e9/47349bb3_6eda_2301_8541_7155ef1b19e9.xml)

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Center / Facility:
Johnson Space Center (JSC)

Responsible Program:
Center Innovation Fund: JSC CIF

Project Management

Program Director:
Michael R Lapointe

Program Manager:
Carlos H Westhelle

Project Manager:
Satish C Reddy

Principal Investigator:
Satish C Reddy

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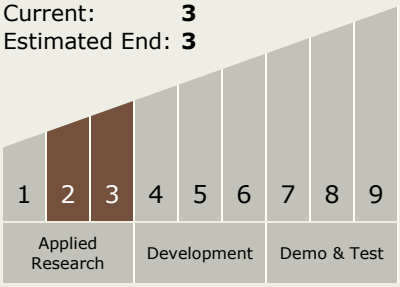
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - TX06.3 Human Health and Performance
    - TX06.3.2 Prevention and Countermeasures